

The work was conducted in cooperation with the State Agricultural and Home Bureau officials and county agents, and a part of the expenses were paid by these agencies. The response to the first season's efforts was not only encouraging but surprising, the farmers very evidently appreciating the organization of the service for their benefit. This first season of demonstration showed that the project could not be abandoned. Three years of successful forecast service and the energetic efforts of the people of New York engaged in agricultural extension work had their combined effect, and in the appropriations for the Weather Bureau for the current fiscal year a little less than \$10,000 was made available for the harvest-weather and fruit-spray forecasts projects together. The appropriations did not become effective until July 1, 1924, too late to utilize any of it for the fruit-spray work; but in the meantime Doctor Wilson, Mr. Fisher, and the remainder of the force at the Ithaca office worked out a splendid program and organization which were ready to go into action on that date.

The harvest-weather forecast work this year was confined to July and August. It was recognized that it should have been extended into September, but since it was the first year of the expanded and organized service caution in respect to appropriations and expenditures had to be exercised. As a result the bureau kept well within the available funds. Therefore next year, provided telegraph rates remain the same (which now seems very doubtful), additional counties will come within the provisions for service.

The project involves many unique features and in a way marks an epoch in the work of the Weather Bureau in service directly for the benefit of farmers. It is perhaps not so spectacular as the fruit-spray service, but from the standpoint of the number of individuals benefited, aggregate value of the crops affected, and total economic returns in prevention of losses, it far transcends the fruit-spray activities. Therefore, the phrasing and interpretation of the forecasts will be given in some detail.

The system of phrasing the forecasts was designed to meet practical problems in a practical way and is employed invariably and consistently. It corresponds fairly closely to that used in the regular forecasts issued for the general public:

*Fair, partly cloudy, or cloudy* mean: No rain expected.

*Rain* means: General rain of several hours duration.

*Clearing*: End of rainy spell is approaching.

*Showers*: Rain at intervals, probably light.

*Thunderstorms*: Local thunderstorms; forecaster unable to specify exact time, locality, or intensity.

To the foregoing terms, words are added to indicate the probability of the weather occurring as forecast; that is, the weight that should be given to the day's forecast, as follows:

*Strongly indicated*: Weight 90 to 100 per cent.

*Indicated*: Weight 70 to 80 per cent.

*Unsettled or probable*: Weight 50 to 60 per cent.

An example of an actual forecast is: "Good drying weather strongly indicated for Wednesday; also indicated for Thursday; Friday unsettled, probably rain."

Cards explaining the terms used in the forecasts and the weight to be applied were distributed to practically every farmer in the counties concerned. With a forecast such as given in the above-quoted example a farmer could plan his work with reasonable assurance of fine weather for one day and probably two, but must take into account the uncertainty of the third day, for which there was more than an even chance for rain.

During the past season 35 counties were served, representing practically all of the important agricultural sections of the State. Responsible persons having contact with the rural telephone lines were selected to act as distributors of forecasts. They in turn secured the names and addresses of every farmer having telephone service. A notice regarding the service, the card explaining the form and terms of the forecast, and a pamphlet of an educational nature giving elementary facts regarding weather forecasting, the movement of storms, etc., were sent to each of these farmers.

A message, usually telegraphic, but occasionally by telephone, containing forecasts applicable to his section, was sent daily, Sundays excepted, to each distributor, reaching him as a rule before 11 a. m. In most cases the farmers called the distributors between 11 a. m. and 1 p. m., but in some instances the distributors called the subscribers on each line by a significant ring, so that all who desired to do so could listen in while the forecasts were read.

The total number of distributors employed last season was 258, an average of 8 or 9 to a county. In 5 of the 35 counties the distribution was accomplished entirely by radio through the station of the General Electric Co. at Schenectady. The total number of farmers to whom the forecasts were made available, calculated from the number of telephone subscribers and not including the counties covered by radio distribution, was about 24,000.

At the end of the season a questionnaire card was sent to a considerable number of farmers for the purpose of ascertaining the extent to which the service was used, the general accuracy of the forecasts, and soliciting questions and comments as a guide in preparing for the next season's work. Returns were received from 2,218 persons. Of this number 1,907 indicated that they used the forecasts in their harvesting operations and 311 said they did not, but of this latter class 198 said they believed the service would be of value to them and that they intended to try it next year. Only 29 expressed the opinion that it was of no use to them and that they did not want it.

#### THE CLIMATE OF TRINIDAD, B. W. I.<sup>1</sup>

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The island of Trinidad, British West Indies, is located about 10° north of the Equator, off the mouth of the Orinoco River. Along the northern coast of the island runs a mountain range, its highest peaks reaching elevations a little over 3,000 feet (900 meters). South of this there are two belts of moderate relief (fig. 1), trending roughly northeast-southwest. Between these belts there are two areas of lower relief, partly a dissected plain, and partly flatlands and swamps. The climate of this island may be classified as a rainy, low-latitude climate, modified by an insular position.

*Temperature*.—Complete, long-period weather observations are available only for the St. Clair Experiment Station (Port of Spain). This station is located 66.7 feet (20.3 meters) above sea level, on the lee side of the island (fig. 1). Its records go back to 1862, and may be taken as fairly typical of the whole island as regards temperature conditions.

The average annual temperature for the period 1907–1916 was 77.3° F. (25.2° C.). The annual range is char-

<sup>1</sup> Read before the American Meteorological Society, Washington, D. C., Jan. 2, 1925. Data from Trinidad official statistics and from observation in the field.

acteristically equatorial, being only  $3.2^{\circ}$  F. ( $1.8^{\circ}$  C.). It varies from  $75.6^{\circ}$  F. ( $24.2^{\circ}$  C.) in January, to  $78.8^{\circ}$  F. ( $26^{\circ}$  C.) in May. The average daily range is  $16.7^{\circ}$  F. ( $9.3^{\circ}$  C.). On clear days and in the dry season the diurnal ranges are greater than on cloudy days and in the rainy season. February, the driest month, has the highest average daily range,  $19.2^{\circ}$  F. ( $10.1^{\circ}$  C.); while August, the rainiest month, has the lowest,  $14.4^{\circ}$  F. ( $8.0^{\circ}$  C.). The highest temperature recorded is  $101^{\circ}$  F. ( $38^{\circ}$  C.) in the month of September, and the lowest  $57^{\circ}$  F. ( $14^{\circ}$  C.) in January. Since there is in Trinidad

from the Northern Range about three-fourths of the distance to the southern coast, and lying inland from the east coast about 5 miles (8 kilometers), there is a belt of over 100 inches (2,500 millimeters) of rainfall. Since the island lies within the range of the belt of equatorial rains, and since the mountain ranges run parallel to the direction of the prevailing winds, there is no arid or semiarid lee coast such as is commonly found on islands in the trade wind belts. The western side of Trinidad however, receives less than 60 inches (1,524 millimeters) of rainfall, and on the westernmost islands of the Bocas

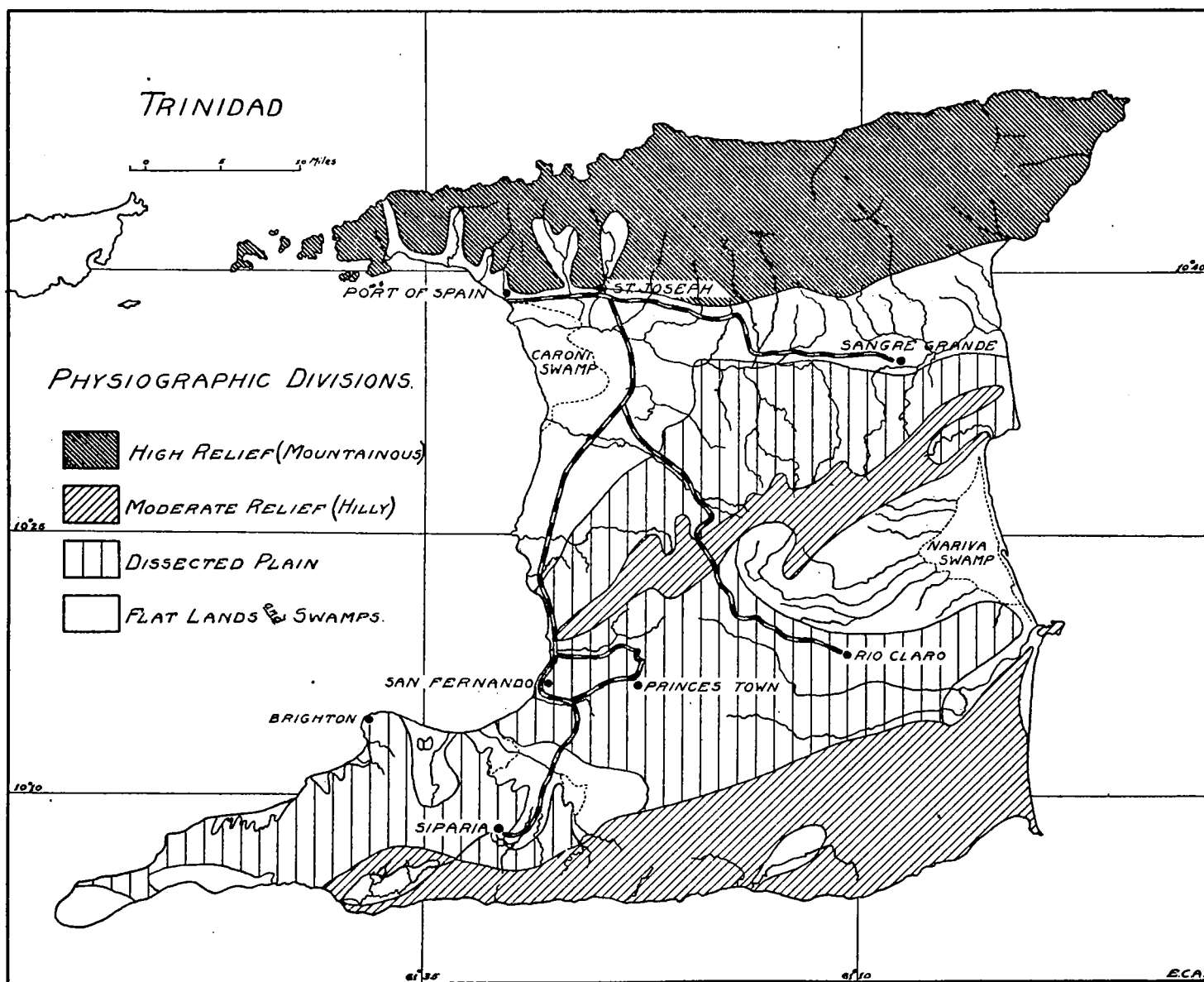


FIG. 1.—Physiographic divisions of Trinidad.

very little land high enough to reach the *Tierra Templada*, these data are essentially typical of the whole island. Slightly greater daily ranges are undoubtedly found in the deep, basinlike valleys of the Northern Range, but the differences would not be critical.

**Rainfall.**—The variety of the surface features of Trinidad is reflected in the marked differences in the amount of rainfall received at various stations (fig. 2). In the northeastern part of the Northern Range a fall of over 150 inches (3,800 millimeters) has been unofficially but competently recorded. Extending southward

(between Trinidad and Venezuela) the fall is less than 50 inches (1,270 millimeters). With the high evaporation at these latitudes, and possibly unfavorable soil or drainage conditions, this rainfall is sufficient only to support a marked xerophytic vegetation on these Bocas islands.

The rain comes in the form of convectional showers, usually accompanied by lightning and thunder, and followed by periods of brilliant sunshine. The showers form in the belt of over 100 inches and drift westward over the island with diminishing violence, usually

following the axes of the mountain or hilly belts, where the up-valley winds supplement the convectional currents. The larger amount of rainfall received in these areas of rough surface can be seen on the rainfall map (fig. 2).

The rainy part of the year comes later in Trinidad than it does farther south along the Guiana and Amazon coast.<sup>2</sup> There is no month of the year in any part of Trinidad which is rainless; but the rains are distributed in a marked rainy season from June to December and a marked dry season from January to May. All of the

TABLE 1.—Average monthly rainfall by seasons at selected stations (in inches)

Station	Dry season (January–May)	Rainy season (June–December)
St. Clair	2.2	7.4
Grande Riviere	4.7	11.3
Couva	1.6	6.5
Siparia	2.8	8.2

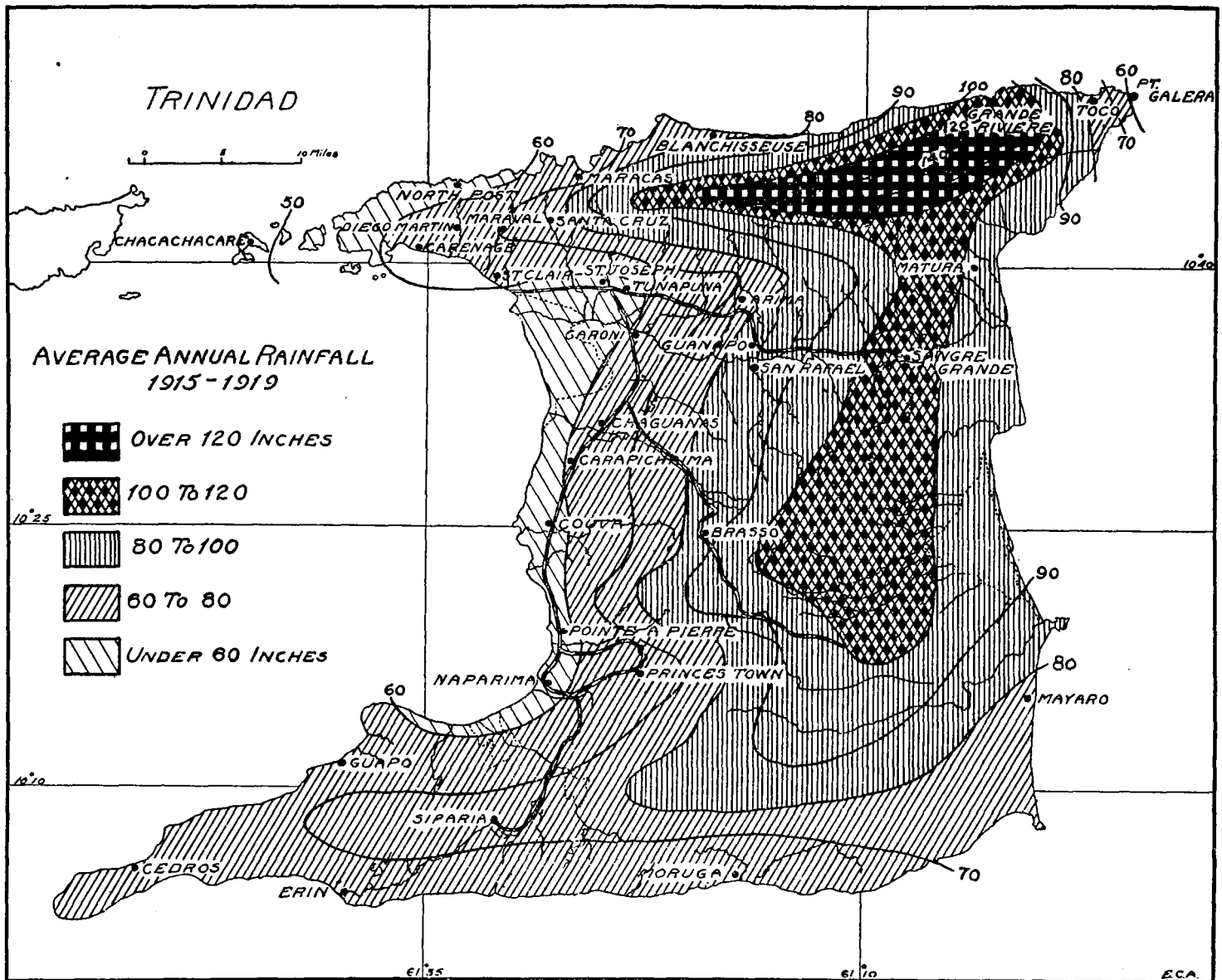


FIG. 2.—Average annual rainfall of Trinidad.

Trinidad stations show a tendency to a double maximum during the rainy season, the first in July–August and the second in November. Between these, September appears regularly as a month of less rain, although less strongly marked in some parts of the island than in others. This characteristic distribution may be seen on the charts for St. Clair, Grande Riviere, Couva, and Siparia (fig. 3). (For the location of these stations see Figure 2.) Table 1 gives the average monthly rainfall for the dry season and the rainy season at these stations.

<sup>2</sup> W. G. Reed. South American Rainfall Types. Quart. Journ. of the Royal Met. Soc. Vol. 34, January, 1910.

At most of the stations the largest amount of rainfall comes in July or August. St. Clair, for example, has a maximum of 9.7 inches (246.4 millimeters) in August. However, the stations along the exposed windward coasts, as Grande Riviere, receive as much rain in November as in the early maximum. At Grande Riviere 13.9 inches (353.1 millimeters) is the average for July, and 14 inches (355.6 millimeters) the average for November. The driest months are February or March. At St. Clair the driest month, February, receives 1.5 inches (38.1 millimeters); and Grande Riviere in March receives 2.6 inches (66 millimeters). At St.

Clair the largest amount of rainfall recorded for any 24-hour period was 5.9 inches (149.9 millimeters) in October. At the constabulary station at Sans Souci, located a little east of Grande Riviere on the north coast

world-wide conditions is suggested by a comparison with the rainfall for Corrientes, Argentina.<sup>3</sup> At this station the changes from one year to the next in 60 per cent of the cases are opposite. Plainly these fluctuations are not the result of any purely local influences.

**Humidity.**—Cloudiness and humidity reach a maximum in August, September, and October. At Port of Spain the average relative humidity (combining the observations for 7 a. m. and 3 p. m.) is 80 per cent. The highest relative humidities are, as usual, found in the early morning, averaging as high as 96 per cent at 7 a. m. in October and for the year at that time 93 per cent. The relative humidity is over 90 per cent at the morning observation for each month of the year. The average for the year at 3 p. m. is 72 per cent, and in April at this time only 66 per cent.

The humidity differs in different parts of the island with the rainfall. However, the most humid parts seem to be in the basin-like valleys in the Northern Range (fig. 1), where the winds are shut out by surrounding slopes, and the eastern coast, where the warm trades sweep onto the land laden with moisture, so that the mist is visible in the distance throughout the day. At Mayaro (fig. 2) a wet-bulb temperature (sling psychrometer) of 77.5° F. (25.3° C.) was recorded at 8 a. m. on August 31, 1924. At this same time the dry-bulb temperature was 82° F. (27.8° C.), giving a relative humidity of 82 per cent. Doctor C. F. Brooks<sup>4</sup> recorded a wet-bulb (sling psychrometer) temperature of 75.2° F. (24° C.) and a dry-bulb temperature of 81.8° F. (27.7° C.) at 10 a. m. on March 13, 1924, at a point near Sangre Grande (fig. 2).

**Winds.**—The prevailing wind in Trinidad is the trade, which at this latitude comes from almost due east.

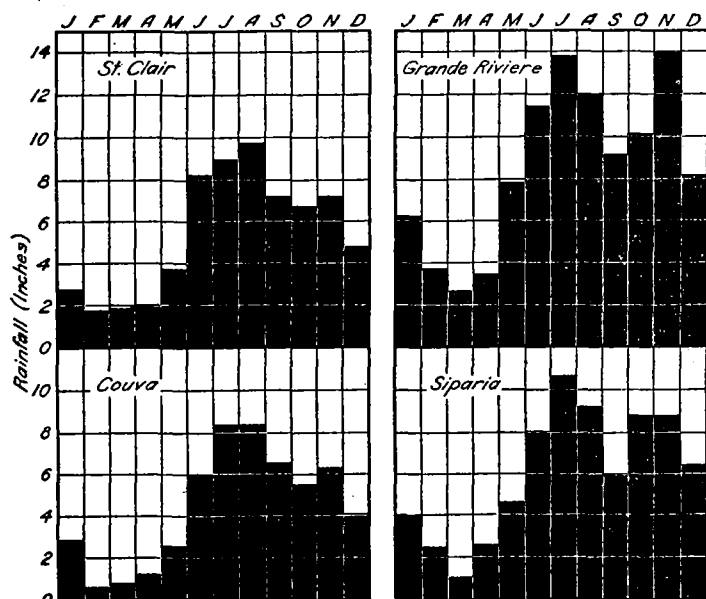


FIG. 3.—Annual march of rainfall at four stations in Trinidad

(fig. 2), 17.54 inches (445.5 millimeters) was recorded on the 7th of October, 1921.

The amount of rain received from year to year shows a considerable variability, as is indicated by the record for St. Clair from 1862 to 1919 (fig. 7). The average

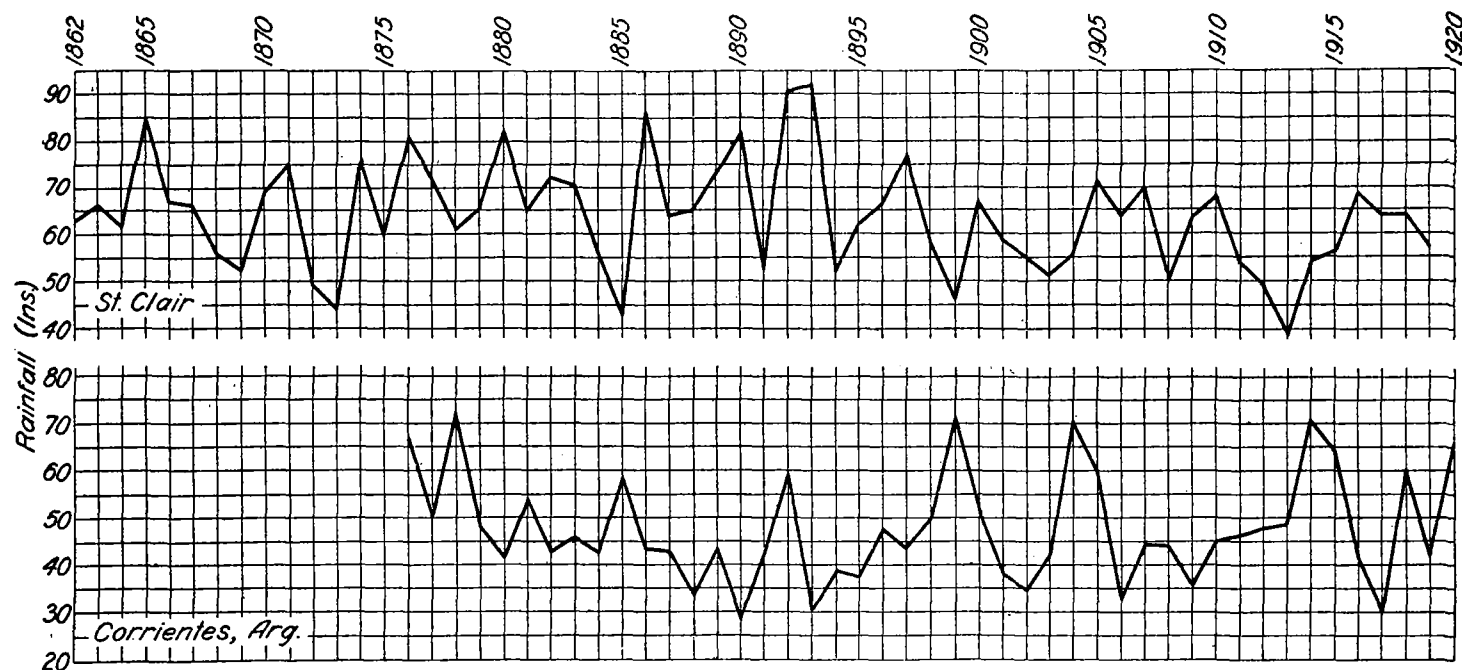


FIG. 4.—Annual variations in rainfall at St. Clair, Trinidad, and Corrientes, Argentina

annual rainfall for this period is 64.28 inches (1,633 millimeters). The chart shows that up to about 1893 the rainfall on the whole was increasing in amount, but that from 1893 to 1913 the trend was a steady decrease. This diminishing rainfall since 1893 has been attributed by many people in Trinidad to the cutting off of the forests. That this trend is, on the contrary, related to

The strength of the wind is notably greater during the period of low sun and the dry season than during the rainy season. For Port of Spain the average wind velocity for the period 1919–1922 was 6.26 miles per hour. The average for the dry season was 7.08 and for

<sup>3</sup> Data furnished by Dr. H. H. Clayton.

<sup>4</sup> Personal conference with Dr. Charles F. Brooks.

the rainy season 5.70. Furthermore, of all the days observed during this period, 86 per cent had at least a five-minute period during which the wind velocity was 25 miles (40 kilometers) per hour or over. This degree of windiness was observed 94 per cent of the days in the dry season and 83 per cent of the days in the rainy season.

During the dry season the wind reaches the western-most parts of the island with characteristic trade-wind force, but during the rainy season it is felt for only a few miles inland from the eastern coast. Sometimes at this period of the year it dies down sufficiently at night for the development of a land breeze on the eastern coast in the opposite direction to the prevailing wind. Such a shift of wind was observed at Mayaro (fig. 2) during the night of August 30-31, 1924. While the land breeze was blowing, mosquitoes in great numbers from the swamps back of the coast (fig. 1) were blown out over the coastal villages. The large amount of cacao grown on Trinidad requires some form of protection from the strong trades. These winds do not, as is often stated, break off the cacao pods, but rather they increase evaporation and decrease the [relative] humidity, a condition which is fatal to cacao. An interesting feature of the wind protection is the relatively narrow belt of trees which is sufficient to shut out the winds. Cacao plantations near Sangre Grande and along the northeastern coast are planted very close to the exposed shore. In a coconut plantation along the immediate coast near Mayaro no wind could be felt about 200 yards (180 meters) from the beach at a time when a strong on-shore trade was blowing.

*Weather types.*—The weather types at Port of Spain may be taken as typical of at least the drier western part of the island. The usual combinations of temperature, rainfall, and wind velocity could not be made owing to the lack of simultaneous records. The rainfall and temperature data cover the period from 1915-1919, but the wind data, as previously mentioned, are from 1919-1922. However, a large percentage of the days are "windy," so that the absence of [a long record of] this

element is less serious than might be the case in a less uniform climate.

The following combinations of temperature and rainfall were made:

Temperature (daily mean from maximum and minimum). { Warm: Under 68° F. (20° C.).  
Hot: 68° F. to 80° F. (20° to 26° C.).  
Very hot: Over 80° F. (26° C.).

Rainfall (daily total). { Fair: Less than 0.01 inch (0.25 millimeter).  
Rainy: 0.01 to 0.99 inch (0.25 to 25.15 millimeters).  
Very rainy: Over 0.99 inch (25.15 millimeters).

These were combined into eight weather types as follows: Hot and fair, hot and rainy, hot and very rainy, very hot and fair, very hot and rainy, very hot and very rainy, warm and rainy, warm and very rainy. Warm and fair did not occur at all during the period studied. The percentage of the total number of observations on which each of these types occurred is shown in Table 2.

The type hot and fair was the most common one, taking 48 per cent of the time. Hot and rainy occurred 41 per cent of the time, while the other types were much less common. The uniformity of temperature, characteristic of the rainy low latitudes, is revealed by this repetition of daily means between 68° F. (20° C.) and 80° F. (26° C.). Very hot days were more common during the dry season than during the rainy season, the percentages being 7.4 and 6.7, respectively, while warm days occurred very seldom, and never during the dry season.

The percentage of rainy and fair days is illuminating in relation to the terms rainy and dry seasons. During the dry season 69 per cent of the days were fair, 30.4 per cent were rainy, and 0.6 per cent were very rainy. During the rainy season, 40.7 per cent of the days were fair, 53 per cent were rainy, and 6.3 per cent were very rainy. These figures are probably essentially characteristic of stations in this type of climate.

TABLE 2.—Occurrence of weather types at Port of Spain

(Figures are percentages of total days of observation)

Weather types	Jan- uary	Feb- ruary	March	April	May	June	July	Aug- ust	Sep- tember	Octo- ber	No- vember	De- cember	Dry	Rainy	Year
Hot and fair.....	62.5	69.5	68.5	61.4	54.3	38.7	32.3	30.3	37.3	37.4	37.3	50.3	63.1	37.7	48.16
Hot and rainy.....	36.2	29.1	28.3	18.0	32.2	51.3	56.7	52.3	50.6	43.2	51.4	47.1	28.9	50.4	41.49
Hot and very rainy.....	1.3	0	0	.6	1.3	6.0	7.1	5.8	6.7	7.8	6.0	2.6	.6	5.9	3.78
Very hot and fair.....	0	1.4	2.6	18.0	7.7	3.3	.6	3.9	3.4	8.4	1.3	0	5.9	3.0	4.21
Very hot and rainy.....	0	0	.6	2.0	4.5	.7	.7	7.7	2.0	3.2	3.3	0	1.5	2.5	2.08
Very hot and very rainy.....	0	0	0	0	0	0	1.3	0	0	0	0	0	0	.2	.11
Warm and rainy.....	0	0	0	0	0	0	.7	0	0	0	0	0	0	.1	.06
Warm and very rainy.....	0	0	0	0	0	0	.6	0	0	0	.7	0	0	.2	.11
Fair.....	62.5	70.9	71.1	79.4	62.0	42.0	32.9	34.2	40.7	45.8	48.6	50.3	69.0	40.7	52.37
Rainy.....	36.2	29.1	39.9	20.0	36.7	52.0	58.1	60.0	52.6	46.4	54.7	47.1	30.4	53.0	43.63
Very rainy.....	1.3	0	0	.6	1.3	6.0	9.0	5.8	6.7	7.8	6.7	2.6	.6	6.3	4.00
Hot.....	100.0	98.6	97.8	80.0	87.8	96.0	96.1	88.4	94.6	88.4	94.7	100.0	92.6	94.0	93.43
Very hot.....	0	1.4	3.2	20.0	12.2	4.0	2.6	11.6	5.4	11.6	4.6	0	7.4	6.7	6.40
Warm.....	0	0	0	0	0	0	.3	0	0	0	.7	0	0	.3	.17